METHOD OF MANAGING POWER AND ELECTRONIC DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.K. Patent Application No. 1513348.1, filed on Jul. 29, 2015, in the U.K. Intellectual Property Office, and Korean Patent Application No. 10-2016-0025762, filed on Mar. 3, 2016, in the Korean Intellectual Property Office, which are incorporated herein in their entirety by reference.

BACKGROUND

[0002] 1. Field

[0003] The present disclosure relates to methods of managing power and electronic devices, and more particularly, to a method of managing power and electronic device based on operation information related to an operation recognizable to a user.

[0004] 2. Description of the Related Art

[0005] With the development of electronic device-related technology, one device is able to perform a variety of functions, and such a device includes various pieces of hardware for supporting the variety of functions. As the various pieces of hardware are included in the device, the importance of power management of each piece of hardware is increasing.

[0006] Hardware power management is performed via various methods, for example, by enabling or disabling certain hardware modules, increasing or decreasing performance of various hardware modules, and changing a hardware operating property, such as a frequency or a voltage. As described above, because various pieces of hardware included in the device involve complex operations, it may be difficult to achieve sufficient reduction in power consumption merely by performing power management on one piece of hardware. Accordingly, a method of managing power may be modified according to usage scenarios of different pieces of hardware. A specific example of such a method of managing power includes advanced power management (APM) developed by Intel and Microsoft and supported and used by Linux kernels.

[0007] Dynamic voltage and frequency scaling (DVFS) is one of a number of methods for performing power management. DVFS may control a voltage and/or a frequency of hardware to increase or decrease according to settings. Generally, when performance needs to be increased, such as when a processing load increases, the voltage and/or the frequency of the hardware may be raised. On the other hand, when power consumption needs to be decreased, the voltage and/or the frequency of the hardware may be lowered. DVFS may be particularly useful in battery-powered devices, such as laptops, tablets, or mobile phones, to conserve power.

[0008] However, there are limitations to DVFS according to general principles of electronic technology. In general, an increase in frequency creates an increase in power and an increase in performance of hardware. However, while a performance increase and frequency and/or voltage increases are linear, an increase in power is a squaring function. Accordingly, performance and power consumption of the hardware may become out of balance under certain circumstances.

[0009] In addition, since DVFS, according to general principles of electronics, operates based on a hardware device, it is difficult to control a frequency and/or a voltage based on an application domain or an application output.

[0010] Accordingly, a conventional method of managing power may attempt to make contradictory decisions under certain circumstances or may lead to fluctuations undesirable in the hardware's performance or power consumption, thus leading to the hardware becoming overheated or having low performance.

SUMMARY

[0011] One or more exemplary embodiments provide methods of managing power and electronic devices based on operation information related to an operation recognizable to a user. According to the disclosed embodiments, performance or power consumption of hardware may be balanced.

[0012] According to an aspect of an exemplary embodiment, a method of managing power of an electronic device may include: obtaining operation information related to an operation from among operations performed by the electronic device, where the operation is recognizable to a user via a product of hardware processing performed by hardware included in the electronic device; obtaining load information related to a load generated by the operation; and performing power management on the hardware included in the electronic device based on the operation information and the load information.

[0013] According to an aspect of another exemplary embodiment, an electronic device may include: hardware configured to execute a process; an output unit configured to output a process result of the hardware to a user; and a controller configured to obtain operation information related to an operation from among operations performed by the electronic device where the operation is recognizable to the user via the process result of the hardware, obtain load information related to a load generated by the operation, and perform power management on the hardware based on the operation information and the load information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The above and other aspects will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings in which:

[0015] FIG. **1** is a diagram showing an exemplary method of managing power;

[0016] FIG. **2** is a flowchart of an exemplary method of managing power;

[0017] FIG. **3** is a graph showing a relationship between frequency and power consumption, according to exemplary benchmark results;

[0018] FIG. **4** is a graph showing a relationship between frequency and frames per second (FPS), according to exemplary benchmark results;

[0019] FIG. **5** is a flowchart of another exemplary method of managing power;

[0020] FIG. **6** is a block diagram of exemplary user settings;

[0021] FIG. **7** is a flowchart showing a process of an exemplary device operating under a normal mode and a power saving mode;